

Serial No.: 10/052,089

Filing Date: January 16, 2002

Title: WIRE-BOND PROCESS FLOW FOR COPPER METAL-SIX, STRUCTURES ACHIEVED THEREBY, AND TESTING METHOD

IN THE CLAIMS

Please amend the claims according to the claim set below. The claim set is intended to reflect amendment of claims 1 and 9, cancellation of nonelected claims 11-23, and addition of new claims 24-36. The specific amendments to individual claims are detailed in the following marked up set of claims.

1. (Currently Amended) A process of forming a wire bond comprising:
forming a protective structure over a metallization copper pad, wherein the metallization copper pad makes contact with a device, and wherein the protective structure includes a metal first film disposed above and on the metallization copper pad and a metal second film disposed above and on the metal first film; and
at the metal second metal film, wire bonding the device.
2. (Original) The process according to claim 1, further including:
by probing the metal second film, electrically testing the device.
3. (Original) The process according to claim 1, before forming a protective structure, further including:
forming a passivation structure that exposes at least a portion of the metallization copper pad.
4. (Original) The process according to claim 1, wherein the metallization copper pad is a metal-six copper (M6 Cu) pad.

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5. (Original) The process according to claim 1, wherein forming a passivation structure includes: forming a first passivation layer over the metallization copper pad; forming a second passivation layer over the metallization copper pad; and patterning the first and second passivation layers to expose at least a portion of the metallization copper pad.

6. (Original) The process according to claim 1, wherein forming a protective structure includes:

forming the metal first film by a process selected from PVD, CVD, electroplating, and electroless plating; and
forming the metal second film by a process selected from PVD, CVD, electroplating, and electroless plating.

7. (Original) The process according to claim 6, wherein forming the metal first film results in a film selected from Ni, Pd, Pt, Co, Rh, Ir, Sc, Yt, La, Ce, Re, Ir, Cu, Au, Ag, Cr, Mo, W, Mn, Tc, Ti, TiW, Zr, Hr, NiB, NiP, NiBP, NiCrB, NiCrP, NiCrBP, NiMoB, NiMoP, NiMoBP, NiWB, NiWP, NiWBP, NiMnB, NiMnP, NiMnBP, NiTcB, NiTcP, NiTcBP, NiReB, NiReP, NiReBP, NiCoB, NiCoP, NiCoBP, NiCoCrB, NiCoCrP, NiCoCrBP, NiCoMoB, NiCoMoP, NiCoMoBP, NiCoWB, NiCoWP, NiCoWBP, NiCoMnB, NiCoMnP, NiCoMnBP, NiCoTcB, NiCoTcP, NiCoTcBP, NiCoReB, NiCoReP, NiCoReBP, CoB, CoP, CoBP, CoCrB, CoCrP, CoCrBP, CoMoB, CoMoP, CoMoBP, CoWB, CoWP, CoWBP, CoMnB, CoMnP, CoMnBP, CoTcB, CoTcP, CoTcBP, CoReB, CoReP, and CoReBP, CoNiB, CoNiP, CoPdBP, CoPdCrB,

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CoPdCrP, CoPdCrBP, CoPdMoB, CoPdMoP, CoPdMoBP, CoPdWB, CoPdWP, CoPdWBP,
CoPdMnB, CoPdMnP, CoPdMnBP, CoPdTcB, CoPdTcP, CoPdTcBP, CoPdReB, CoPdReP,
CoPdReBP, CuB, CuP, CuBP, CuCrB, CuCrP, CuCrBP, CuMoB, CuMoP, CuMoBP, CuWB,
CuWP, CuWBP, CuMnB, CuMnP, CuMnBP, CuTcB, CuTcP, CuTcBP, CuReB, CuReP,
CuReBP, CuNiB, CuNiP, CuNiBP, CuNiCrB, CuNiCrP, CuNiCrBP, CuNiMoB, CuNiMoP,
CuNiMoBP, CuNiWB, CuNiWP, CuNiWBP, CuNiMnB, CuNiMnP, CuNiMnBP, CuNiTcB,
CuNiTcP, CuNiTcBP, CuNiReB, CuNiReP, CuNiReBP and combinations thereof.

8. (Original) The process according to claim 6, wherein forming the metal second film results in a film selected from gold, doré, platinum, and aluminum.

9. (Currently Amended) The process according to claim 1, wherein the metal first film is electrolessly plated with a composition including:

(Sb)
(M) from zero to at least one primary metal selected from cobalt, rhenium, iridium, nickel, palladium, platinum, titanium, zirconium, hafnium, copper, silver, gold, and combinations thereof;

from zero to at least one secondary metal selected from chromium, molybdenum, tungsten, manganese, technetium, rhenium, and combinations thereof;

from zero to at least one primary reducing agent in a concentration range from about 1 gram/liter to about 30 gram/liter;

from zero to at least one secondary reducing agent in a concentration range from about 0 gram/liter to about 2 gram/liter;

a complexing and buffering agent; and

at least one pH adjusting agent.

10. (Original) The process according to claim 1, after wire bonding the device, further including:

removing the wire bonding; and

replacement wire bonding the device.

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Claims 11-23. (Canceled)

24. (New) The process of claim 1, further including:

by probing the metal second film, electrically testing the device, wherein the test probe tip penetrates the metal second film and stops before penetrating the metal first film.

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25. (New) The process according to claim 1, further including:

by probing the metal second film, electrically testing the device; and

following passing a test current, further including:

first bonding a first bond wire to the metal second film.

26. (New) The process according to claim 1, further including:

by probing the metal second film, electrically testing the device; and

following passing a test current, further including:

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first bonding a first bond wire to the metal second film;
removing the first bond wire; and
second bonding a second bond wire to the metal second film.

27. (New) The process according to claim 1, wherein forming a passivation structure

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includes:

forming a first passivation layer over the metallization copper pad;
forming a second passivation layer over the metallization copper pad; and
patterning the first and second passivation layers to expose at least a portion of the
metallization copper pad, wherein patterning the first and second passivation layers forms a slope
that has an angle in a range from about 30° to about 60°.

28. (New) The process according to claim 1, wherein forming a protective structure includes:

forming the metal first film by electroless plating in a reducing environment; and
forming the metal second film by a process selected from PVD, CVD, electroplating, and
electroless plating.

29. (New) The process according to claim 1, wherein the metallization copper pad is a
nickel-coated copper pad, wherein the metal first film is formed by electroless plating, and
wherein the electroless plating includes:

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from zero to at least one primary reducing agent in a concentration range from about 1
gram/liter to about 30 gram/liter; and

from zero to at least one secondary reducing agent in a concentration range from about 0
gram/liter to about 2 gram/liter.

30. (New) The process according to claim 1, wherein the metallization copper pad is a
nickel-coated copper pad, wherein the metal first film is formed by electroless plating, and
wherein the electroless plating includes:

from zero to at least one primary reducing agent in a concentration range from about 1
gram/liter to about 30 gram/liter; and

from zero to at least one secondary reducing agent in a concentration range from about 0
gram/liter to about 2 gram/liter; and

wherein the metal second film is formed by electrolessly plating gold.

31. (New) The process according to claim 1, further including:

by probing the metal second film, electrically testing the device;

first bonding a first bond wire to the metal second film;

removing the first bond wire; and

second bonding a second bond wire to the metal second film.

32. (New) The process according to claim 1, further including:

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by probing the metal second film, electrically first testing the device;

first bonding a first bond wire to the metal second film;

removing the first bond wire;

second bonding a second bond wire to the metal second film; and

by probing the metal second film, electrically second testing the device, wherein

electrically second testing the metal second film includes an ohmic resistance change in a range

from about 50% reduction to about 150% improvement over electrically first testing the device.

33. (New) A process comprising:

forming a protective structure over a metallization copper pad, wherein the metallization copper pad makes contact with a device, and wherein the protective structure includes a metal first film disposed above and on the metallization copper pad and a metal second film disposed above and on the metal first film; and

at the metal second film, wire bonding the device;

wherein the metal first film is electrolessly plated with a composition including:

from zero to at least one primary metal selected from cobalt, rhenium, iridium, nickel, palladium, platinum, titanium, zirconium, hafnium, copper, silver, gold, and combinations thereof;

from zero to at least one secondary metal selected from chromium, molybdenum, tungsten, manganese, technetium, rhenium, and combinations thereof;

from zero to at least one primary reducing agent in a concentration range from about 1 gram/liter to about 30 gram/liter;

from zero to at least one secondary reducing agent in a concentration range from about 0 gram/liter to about 2 gram/liter;

a complexing and buffering agent; and

at least one pH adjusting agent.

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34. (New) The process according to claim 33, further including:
by probing the metal second film, electrically testing the device.

35. (New) The process according to claim 33, wherein the metal first film is nickel, and
wherein the metal second film is gold.

36. (New) The process according to claim 33, wherein the metal first film is titanium, and
wherein the metal second film is aluminum.
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